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TITLE: Magnetization reversal and spin structures in nanoscale antidot arrays

AUTHORS (LAST NAME, FIRST NAME): Heyderman, Laura J.[1]; Nolting, Frithjof[1]; Backes, Dirk[1, 3]; Czekaj, Slawomir[1]; Mengotti, Elena[1]; López-Díaz, Luis[2]; Kläui, Mathias[3]; Rüdiger, Ulrich[3]; Vaz, Carlos[4]; Bland, Tony[4]; Matelon, Raphael J.[5]; Volkmann, Ulrich[6]; Fischer, Peter[7]; Craig, Beverley R.[8]; Chapman, John N.[8]

INSTITUTIONS (ALL): 1. Paul Scherrer Institut, Villigen, Switzerland.
2. Dpto. Fisica Aplicada, Universidad de Salamanca, Salamanca, Spain.
3. Fachbereich Physik, Universität Konstanz, Konstanz, Germany.
4. Cavendish Laboratory, University of Cambridge, Cambridge, United Kingdom.
5. School of Engineering, Computer Science & Mathematics, Exeter University, Exeter, United Kingdom.
6. Facultad de Física, Pontificia Universidad Católica de Chile, Santiago, Chile.
7. LBNL/CXRO, Berkeley, CA, USA.
8. Physics and Astronomy, Glasgow University, Glasgow, United Kingdom.

ABSTRACT BODY: On introducing a regular array of holes into a continuous thin film, not only can the magnetic properties be modified, but also domain wall behaviour and interactions can be investigated, a topic which is of interest for future magnetic devices utilising the manipulation of domain walls. We have carried out a detailed study of the magnetic switching in square lattice cobalt antidot arrays with periods ranging from 2 μm down to 200 nm (antidot size = antidot separation) [1, 2]. Magnetooptical Kerr effect measurements show first a small reversible change in the magnetization via spin rotation, followed by a large change of the magnetization due to reversal of the antidot array columns parallel to the applied field. Employing x-ray photoemission electron microscopy and transmission x-ray microscopy, the latter irreversible process was observed as a nucleation and propagation of discrete domain chains, followed at higher fields by a similar switching via perpendicular chains along the rows. These experimental observations were reproduced by micromagnetic simulations with the applied magnetic field at a small angle to the columns. The position of the ends of the domain chains is modified by the presence of the perpendicular domain chains during reversal: the ends of orthogonal domains coincide to form a stable 180° wall configuration in 10 nm-thick films. In thicker 40 nm films, a configuration with four 90° occurs due to the increased importance of the stray field energy. In addition, the advancing longitudinal chain ends are blocked as they approach a perpendicular chain due to the formation of 360° boundaries, resulting in several chain ends in a row. Observations with Lorentz microscopy reveal a complex switching behaviour when the magnetic field is applied at 45°.

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[1] L.J. Heyderman et al. Appl. Phys. Lett. 83 (2003) 1797
[2] L.J. Heyderman et al. Phys. Rev. B 73 (2006) 214429

KEYWORDS: antidot arrays, domain structures, electron beam lithography, x-ray and Lorentz microscopy.

(No Table Selected)